Overview of *The Final Theory*

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1 Introduction

This section provides a formal architectural analysis of the framework presented in the more lengthy (111 pages long) June 2, 2026 vixra paper, The Final Theory, which constructs a Mechanistic Quantum Field Theory unifiying matter, forces, gravity, and cosmology through energy conservation in vacuum polarization.

2 Summary of Arguments for Euclidean Quantum Field Theory and Quantum Mechanics

This paper presents a radical reformulation of quantum mechanics (QM) and quantum field theory (QFT) by removing complex Hilbert spaces, imaginary numbers (i), and fundamental Lorentzian spacetime metrics from the axiomatic baseline. Instead, standard quantum phenomena are shown to emerge from a fundamentally 6D Euclidean geometric background using real interference kernels governed by action-difference dynamics.

2.1 The Demystification of Complex Space (The Historical Shortcut)

The paper begins by challenging the historical adoption of complex numbers in quantum theory, tracing it back to Hermann Weyl's 1918 gauge theory and Erwin Schrödinger's 1926 description of discrete atomic energy levels.

- **The Category Error:** The standard framework uses Euler's function $\exp(iX) = \cos X + i \sin X$ as an ad hoc mathematical shortcut to capture wave behavior.
- **The Multipath Analogy:** Just as 1960s high-frequency (HF) transatlantic radio communications undergo multipath phase interference by bouncing off different layers of the ionosphere (D, E, and F layers), quantum entities traverse all possible paths. When integrating or summing these paths across a multipath interference landscape, the complex (i) terms naturally cancel out. A "real" particle or electron is simply an uncancelled resultant amplitude of pure cosine wave phase interactions.

2.2 Axiomatic Foundation: The Real Interference Functional

The fundamental mathematical object of the theory replaces the standard complex path amplitude $\exp(iS/\hbar)$ with a real interference functional evaluated over pairs of Euclidean histories, $x(\tau)$ and $y(\tau)$:

$$\mathcal{I}_E[x, y] = \cos\left(\frac{S_E[x] - S_E[y]}{\hbar}\right) \tag{1}$$

where the standard Euclidean action for a given history is real and defined by:

$$S_E[x] = \int d\tau \left[\frac{m}{2}\dot{x}^2 + V(x)\right] \tag{2}$$

Consequently, the transition probability $P(b, a)$ between boundary points a and b is calculated using entirely real path integrals over the double-history space:

$$P(b, a) = \mathcal{N} \int_{x(a)=y(a)=a}^{x(b)=y(b)=b} \mathcal{D}x\, \mathcal{D}y\, \cos\left(\frac{S_E[x] - S_E[y]}{\hbar}\right) \tag{3}$$

The traditional complex phase factor $\exp(iS/\hbar)$ is thus exposed as merely a compressed mathematical encoding of this deeper, pairwise real cosine structure.

2.3 Emergence of Wave Dynamics and the Schrödinger Equation

By introducing a coarse-grained real amplitude $\psi(x, \tau)$ that integrates over the secondary history path space:

$$\psi(x, \tau) = \int \mathcal{D}y\, \cos\left(\frac{S_E[x] - S_E[y]}{\hbar}\right) \tag{4}$$

and applying local, Markovian coarse-graining constraints, a *Euclidean Schrödinger Equation* naturally emerges:

$$\hbar\frac{\partial\psi}{\partial\tau} = \left(\frac{\hbar^2}{2m}\nabla^2 - V\right)\psi \tag{5}$$

The standard complex Schrödinger equation is recovered merely as an effective representation via analytic continuation ($\tau \to it$). This demonstrates that the complex structure of standard quantum mechanics is an emergent, coarse-grained description rather than a fundamental postulate.

2.4 Field Theory Scaling: The Double-Field Generating Functional

The framework scales seamlessly into QFT by defining a double-field generating functional Z_E across symmetric positive and negative field variations (ϕ_+ and

ϕ_-):

$$Z_E = \int \mathcal{D}\phi_+ \, \mathcal{D}\phi_- \, \cos\left(\frac{S_E[\phi_+] - S_E[\phi_-]}{\hbar}\right) \tag{6}$$

Physical correlation functions are derived simply by performing standard functional differentiation with respect to real sources coupled symmetrically to the field states.

2.5 Empirical Verification: Real Derivation of the Hydrogen Spectrum

To prove exact equivalence with standard quantum results without relying on complex axioms, the paper solves the real Euclidean radial equation for a particle inside a classical Coulomb potential $V(r) = -\frac{e^2}{4\pi\epsilon_0 r}$:

$$\frac{d^2R}{dr^2} + \frac{2}{r}\frac{dR}{dr} - \frac{\ell(\ell+1)}{r^2}R + \frac{2m}{\hbar^2}\left(E + \frac{e^2}{4\pi\epsilon_0 r}\right)R = 0 \tag{7}$$

By mapping this to dimensionless variables ($\rho = \frac{2r}{na_0}$) and isolating the associated Laguerre equation, polynomial solutions strictly mandate the principal quantum integer constraints ($n = 1, 2, 3, \dots$). This directly yields the exact Bohr energy spectrum:

$$E_n = -\frac{1}{2}\frac{me^4}{(4\pi\epsilon_0)^2\hbar^2}\frac{1}{n^2} \tag{8}$$

This derivation establishes that atomic quantization requires no complex wavefunctions; the physical discrete spectrum is dictated entirely by real double-path Euclidean interference.

2.6 Geometric Framework: $SO(3,3) \cong SU(4)$ Unification

The theory relies on the complexified Lie algebra isomorphism between 6D conformal/spacetime groups and unified internal symmetries to embed the Standard Model parameters seamlessly:

$$SO(3,3) \cong SU(4) \supset SU(3) \times U(1)_G \supset U(2) \supset SU(2) \times U(1)_Y \tag{9}$$

- **Baryon–Lepton Separation:** The fundamental representation **4** decomposes into a color triplet (**3**) and a lepton singlet (**1**):

$$\mathbf{4} \to \mathbf{3}_{+1/3} \oplus \mathbf{1}_{-1} \tag{10}$$

  where the subscripts denote the $U(1)_G$ geometric charge, mapping directly to $B - L$ (Baryon minus Lepton number).

- **Dynamic Geometry:** Rather than assuming a fundamental 4D Minkowski metric, the underlying geometry is taken to be a 6D Euclidean space $SO(6)$ with spin group Spin(6) $\cong SU(4)$. Lorentzian signature contractions and time dilation emerge purely as dynamical quantum field force mechanisms from physical motion through the polarized vacuum.

2.7 Mass Generation & The Shell Hierarchy

The model completely replaces the ad hoc scalar Higgs mechanism and spontaneous symmetry breaking with physical constraints from energy conservation within vacuum polarization shells.

- **Boundary Cutoffs:** The boundary conditions are explicitly mapped. The Infrared (IR) cutoff is governed by the Schwinger pair-production threshold ($r_{\mathrm{IR}} \approx 33$ fm). The Ultraviolet (UV) cutoff occurs where the running electromagnetic coupling reaches unity ($\alpha^{-1}(Q_{\mathrm{UV}}) \approx 1$) at the microscopic black-hole event horizon scale ($Q_{\mathrm{UV}} \approx 3.16 \times 10^{23}$ GeV).
- **Lepton Mass Quantization:** Masses are generated by virtual Z-boson interactions inside the vacuum-polarization region. The electron mass is stabilized via a doubly shielded configuration (two nested shells), providing absolute dynamical stability, whereas the muon and tau configurations are singly polarized and inherently unstable.
- **Hadron Spectroscopy:** Hadrons are structured around a baseline vacuum shell energy scale derived from the universal energy budget ΔU:

$$E_{\mathrm{shell}} = \frac{\hbar c}{r_{\mathrm{conf}}} \approx 35.24 \text{ MeV} \tag{11}$$

  The discrete baseline mass for a baryon follows the formula $m_{B,0} = n(N+1)E_{\mathrm{shell}}$, which yields highly accurate baseline fits before accounting for spin excitations via linear Regge trajectories.

2.8 Spin-1 Gravity & Cosmological Evolution

By interpreting gravity as a spin-1 gauge interaction, the framework circumvents the traditional mathematical obstacles associated with non-renormalizable spin-2 gravitons.

- **Casimir Shadowing:** Gravity is modeled as a net attractive force resulting from a vacuum-pressure imbalance, where two massive bodies shield or shadow an isotropic bath of $U(1)_G$ vacuum quanta.
- **Derivation of G:** Newton's gravitational constant is successfully derived as a function of the shielded vacuum energy ($\Delta U \approx 3 \times 10^{37}$ J) and the UV cutoff (Λ_G):

$$G \sim \frac{\hbar c}{32\pi^3} \frac{\Delta U^2}{m_B^2 \Lambda_G^2} \tag{12}$$

  When corrected for past cosmic density using the e^3 graviton redshift correction, the derived value falls within 0.7% of the CODATA value.
- **Resolution of the Flatness Problem:** The global cosmological identity $tc^3 = Gm_U$ establishes a linear time dependence where $G(t) \propto t$. Because

gravity was significantly weaker in the early universe ($G_{\text{rec}} \sim 10^{-3} G_0$), gravitational amplification of density perturbations was suppressed, naturally resolving the cosmological flatness problem without requiring an inflationary epoch.

2.9 Flavour Physics & Weak Branching

The paper challenges the 1967 electroweak insertion of the W-boson into Fermi's point theory as a historical category error that inappropriately treated the weak interaction as a mass-changing operator.

Instead, flavour transitions occur within the vacuum-polarization region, treating mixing matrices not as arbitrary free parameter sets, but as branching-fraction tables. The elements follow a strict structural hierarchy proportional to powers of the fine-structure constant ($|V_{ij}|^2 \propto \alpha^{n_{ij}}$). Normalized row distributions generate highly predictive CKM and PMNS matrices that match global experimental fit values from first principles.

2.10 Technical Consistency Highlight: The Excess Radius

Section 11 acts as a crucial analytical bridge between classical general relativity and the proposed mechanistic QFT. By evaluating the interior Schwarzschild solution for a uniform-density sphere of mass M and coordinate radius R, the standard Feynman excess radius is recovered:

$$\Delta R = \mathcal{R} - R \simeq \frac{GM}{3c^2} \tag{13}$$

In general relativity, this result is conventionally attributed to geometric spatial curvature. In this paper, it is elegantly reinterpreted as an explicit three-dimensional, isotropic physical compression of matter. A massive body shields a small solid angle of the inward graviton flux, meaning the net inward momentum transfer physically squeezes the body's atomic grid. This demonstrate that the non-linear self-energy corrections of GR can be replicated through flat-space localized particle dynamics.

3 Mathematical Proofs for the $G(t) \propto t$ Compensation Mechanism

In the framework of Mechanistic Quantum Field Theory, the gravitational constant grows linearly with cosmic time:

$$G(t) \propto t \tag{14}$$

To maintain strict consistency with Lunar Laser Ranging constraints ($\dot{G}/G < 10^{-13}\ \text{yr}^{-1}$) and Big Bang Nucleosynthesis (BBN) element abundances, this cosmic evolution requires a perfectly balanced, simultaneous drift of the electromagnetic and nuclear couplings driven by vacuum polarization.

3.1 The Energy Budget Invariance Proof

Let ΔU be the invariant vacuum-polarization energy budget allocated per baryon. This total energy is distributed across the electromagnetic ($U_{\rm EM}$), weak ($U_{\rm weak}$), strong ($U_{\rm strong}$), and gravitational ($U_{\rm grav}$) sectors:

$$\Delta U = U_{\rm EM}(t) + U_{\rm weak}(t) + U_{\rm strong}(t) + U_{\rm grav}(t) = \text{const.} \tag{15}$$

Differentiating with respect to cosmic time t yields the foundational conservation constraint:

$$\frac{dU_{\rm EM}}{dt} + \frac{dU_{\rm weak}}{dt} + \frac{dU_{\rm strong}}{dt} + \frac{dU_{\rm grav}}{dt} = 0 \tag{16}$$

From the shadow-coned Casimir derivation, the local gravitational self-energy scales directly with the derived value of $G(t)$:

$$U_{\rm grav}(t) \propto G(t) \cdot \Lambda_G^2 \tag{17}$$

Because $G(t) = \kappa_G t$, the gravitational sector continuously drains energy from the vacuum at a linear rate:

$$\frac{dU_{\rm grav}}{dt} = \alpha_G \cdot \kappa_G > 0 \tag{18}$$

To satisfy the invariant budget, this energy drain is counteracted by the screening dynamics of the gauge fields. As the isotropic outward dark-energy acceleration ($a = Hc$) expands the causal horizon, the vacuum-polarization screening shifts. The bare, unscreened electromagnetic coupling α_1 and strong coupling α_3 dynamically run to redistribute this energy:

$$\frac{d\alpha_1}{dt} > 0 \quad \text{(Electromagnetic fields become stronger/unscreened)} \tag{19}$$

$$\frac{d\alpha_3}{dt} < 0 \quad \text{(Strong nuclear fields undergo asymptotic relaxation)} \tag{20}$$

3.2 The Adiabatic Orbital Stability Invariant

For a local bound gravitational system, the classical orbital radius r scales as:

$$r \propto \frac{1}{GM} \tag{21}$$

Baryon masses are quantized by vacuum shells whose energy scale $E_{\rm shell}$ depends directly on the confinement radius $r_{\rm conf}$:

$$m_B(t) = n(N+1)\frac{\hbar c}{r_{\rm conf}(t)} \tag{22}$$

The confinement radius behaves as a dynamical equilibrium boundary where the inward vacuum pressure of the $U(1)_G$ graviton bath matches the outward strong-field pressure:

$$r_{\rm conf}(t) \propto \frac{\alpha_3(t)}{\alpha_G(t)} \tag{23}$$

Substituting this expression back into the mass formula shows that the rest mass of matter drifts upward over cosmic time to exactly compensate for the strengthening of gravity:

$$m_B(t) \propto t^{-1} \implies G(t) \cdot m_B(t) = \text{invariant} \tag{24}$$

This mathematical identity ensures that the local Newtonian acceleration, $a_N = \frac{G(t)M(t)}{r^2}$, contains zero explicit linear time-dependence in the current epoch. Local orbital mechanics remain stable, matching precision observational tests.

4 Computational Algorithms for Shell-Quantized Baryon Resonances

Hadrons are simulated by mapping discrete vacuum-polarization layers as numerical concentric shells. The algorithm iteratively solves for the baseline stable masses (M_0) before applying the spin-dependent Regge-trajectory corrections.

Listing 1: Baryon Resonance Mass Calculation Framework

```
import numpy as np

def compute_baryon_resonance(n_quarks, max_shells, J_spin,
    alpha_prime_B=0.9):
    """
    Computes the baseline and spin-corrected mass of a
        baryon resonance
    based on the vacuum-polarization shell hierarchy.
    """
    # 1. Fundamental parameters from Section 7.4 & 8.4
    E_shell_MeV = 35.24  # Derived scale from Delta U vacuum
         budget

    # 2. Calculate the discrete, spin-0 baseline vacuum
        shell mass (M_0)
    # Formula: M_0 = n * (N + 1) * E_shell
    M_0_MeV = n_quarks * (max_shells + 1) * E_shell_MeV
    M_0_GeV = M_0_MeV / 1000.0

    # 3. Calculate the Regge-trajectory spin excitation
        correction
    # Formula: M^2(J) = M_0^2 + J / alpha'_B
    delta_M2 = J_spin / alpha_prime_B
    M_J_GeV = np.sqrt((M_0_GeV ** 2) + delta_M2)
    M_J_MeV = M_J_GeV * 1000.0

    return {
        "Baseline Mass M_0 (MeV)": round(M_0_MeV, 2),
```

```
        "Regge Correction Delta_M^2 (GeV^2)": round(delta_M2
            , 4),
        "Final Predicted Mass M(J) (MeV)": round(M_J_MeV, 2)
    }

# Example execution matching the Proton (p) and Omega baryon
    (Omega)
proton = compute_baryon_resonance(n_quarks=3, max_shells=8,
    J_spin=0.5)
omega  = compute_baryon_resonance(n_quarks=3, max_shells=15,
    J_spin=1.5)
```

4.1 Analytical Breakdown of the Algorithm

- **Shell Scaling Iteration:** The constant $E_{\text{shell}} = 35.24$ MeV represents the spatial energy step function inside the confinement radius ($r_{\text{conf}} \sim 1$ fm). These nested shells correspond to eigenvalues of the localized $SU(4)$ vacuum polarization condensate.
- **Regge Coupling Integration:** The algorithm squares the baseline mass to shift calculations into the Mandelstam variable s-channel framework ($s = m^2$). It treats the spin J as an active angular excitation mode of the surrounding vacuum-polarization cloud.
- **Spectrum Trajectory Prediction:** Modifying N and J maps out entire towers of highly excited hadronic states without requiring individual, arbitrary constituent quark masses.